(12) UK Patent Application (19) GB (11) 2 038 886 A

(21) Application No 8000627
(22) Date of filing 9 Jan 1980
(30) Priority data
(31) 2450U
(32) 10 Jan 1979
(33) United States of America (US)
(43) Application published 30 Jul 1980
(51) INT CL³ D06F 37/24
(52) Domestic classification D1A B4 C1 C2 D5A D5B3 D5B5 D6 E9A F5A2 G4B L1D1A L2B N10A2 N7A
(56) Documents cited None
(58) Field of search D1A
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(54) Suspension System for Tub Assembly in Clothes Washing Machine

(57) A tub assembly 22 comprises an outer, stationary tub 24 and an inner tub 66 mounted for rotation on a central shaft 68 extending downwardly through the bottom of the stationary tub. The outer tub is supported by a support cup 54 in the base 18 of the machine, curved legs 40 spaced about the periphery of the outer tub and a second support cup 44 shaped complementarily to the first cup as a truncated hemisphere, and nesting in the first cup. A plurality of springs 60 are tensioned between the tub 24 and base 18 to stabilize the tub assembly. A transmission unit 94, drive pulley 78 and a brake assembly 100 also mounted on the shaft 68 serve as a drive mechanism for the washing machine, the pulley being coupled by a belt to a motor 82. A balance ring 106 of a predetermined weight is mounted on the central shaft as near as is practical to the true centre of mass of the inner rotatable tub and its drive mechanism, (i.e. directly beneath the outer tub) for stabilizing the rotating tub during high speed spinning, even when a clothes load in the tub is out of balance.

FIG. 1

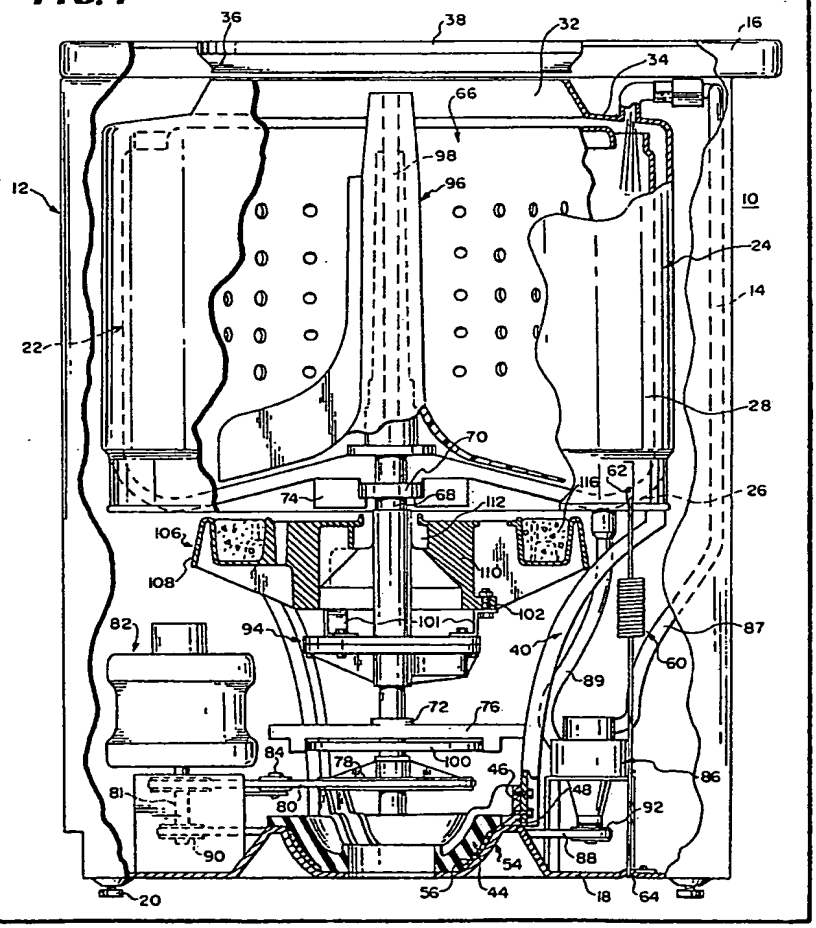

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FIG. 1

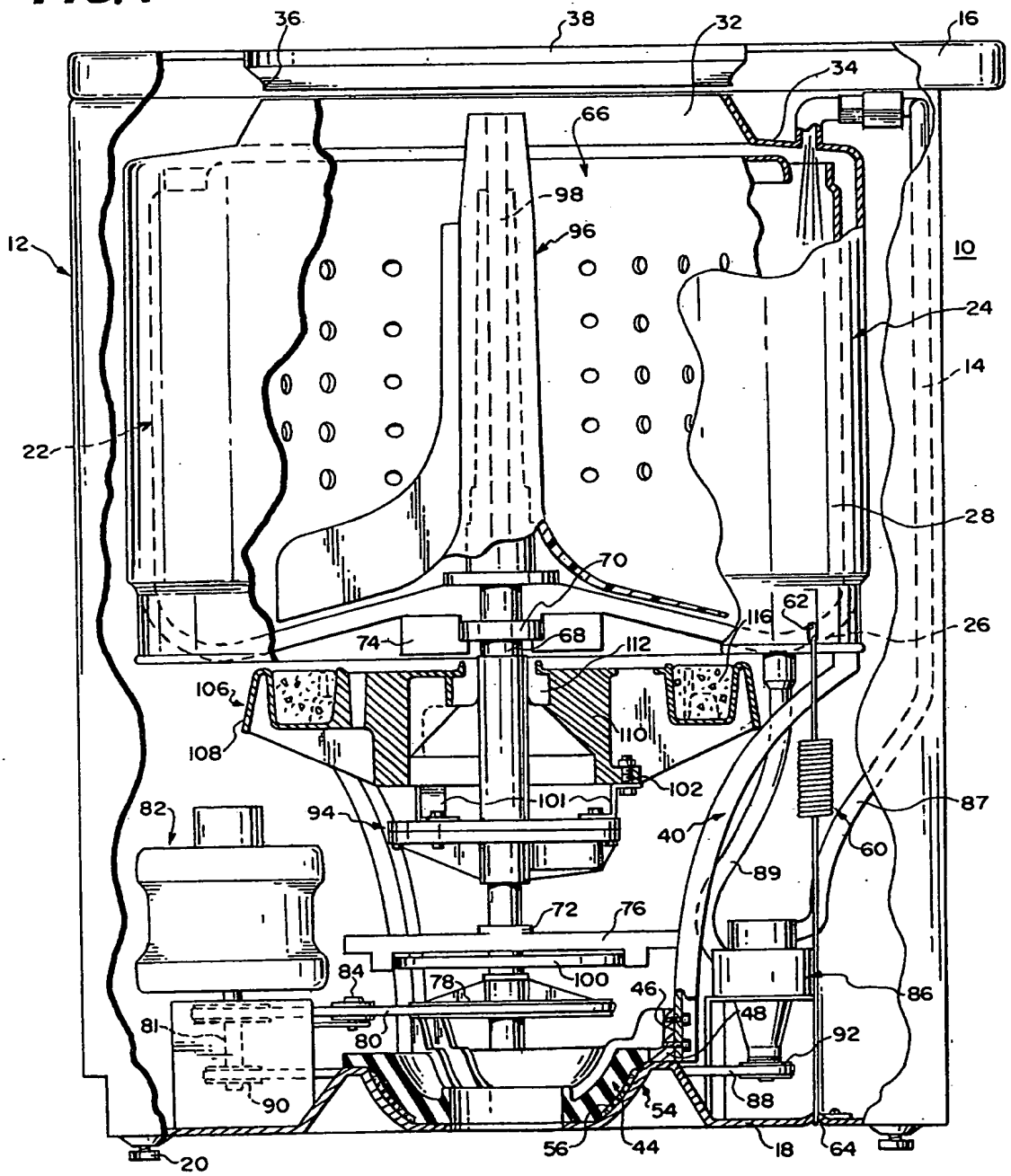
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FIG. 2

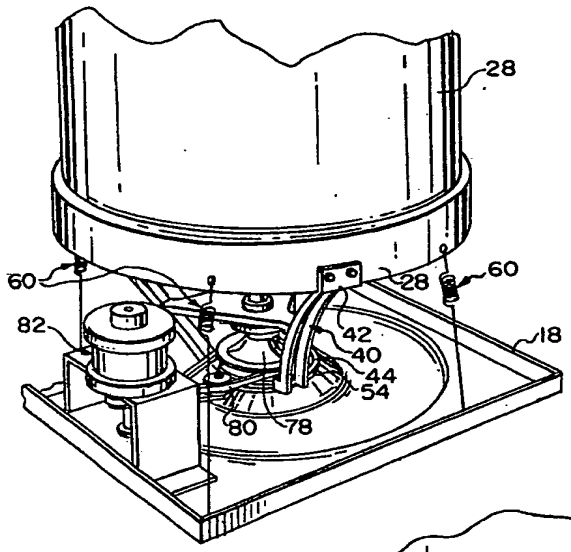


FIG. 4

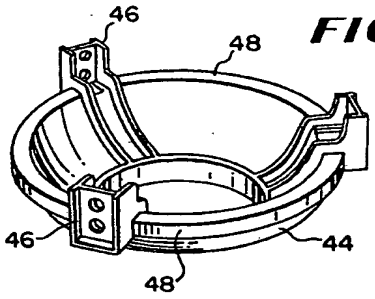


FIG. 5

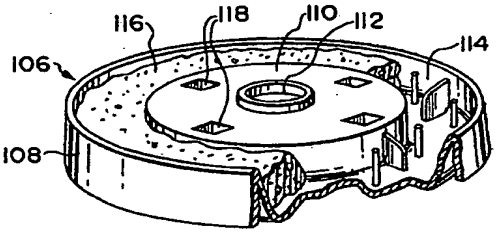
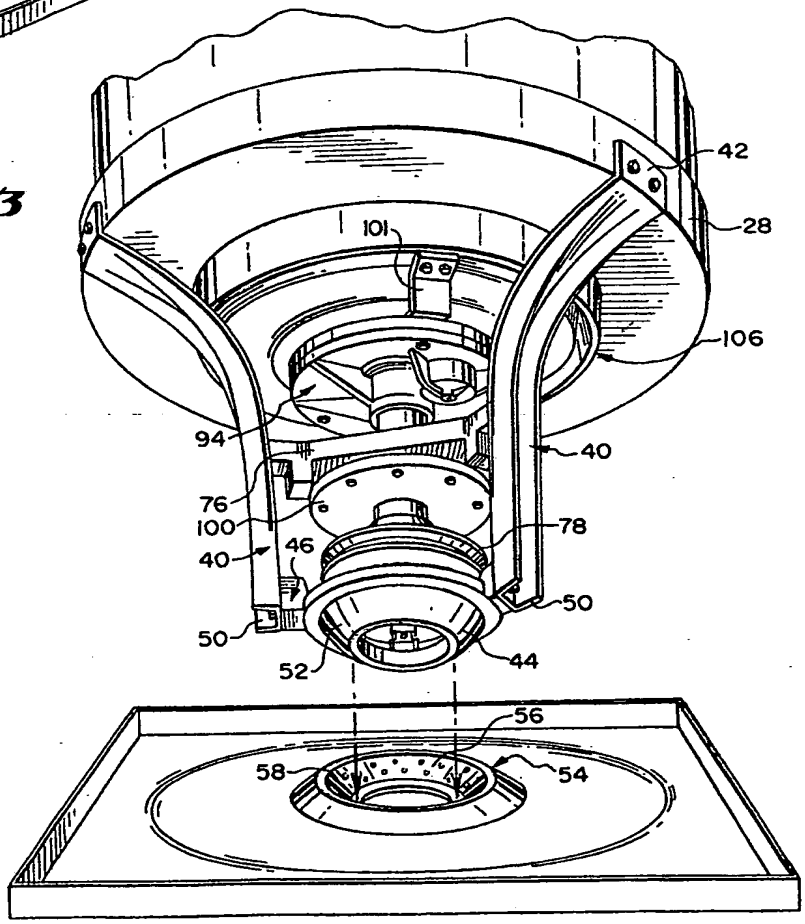


FIG. 3



SPECIFICATION

Suspension System for Tub Assembly in Clothes Washing Machine

This invention relates to a suspension system in a clothes washing machine with a vertically mounted tub assembly including a spin or wash tub into which clothes to be washed are placed.

Different types of suspension systems for supporting the wash tub assembly in a clothes washing machine are known. Many such systems provide stabilization of the spin tub of the tub assembly, especially during the spin cycle when the clothes load therein may be out of balance, to minimize the transfer of vibration from the rotatably mounted spin tub to the washing machine housing and base.

Several such systems employ a downwardly facing convex support member upon which an outer stationary tub in which the rotatable spin tub is received, is mounted. The support member is received in a complementarily shaped support surface, thereby providing a seat for the first mentioned member. Examples of such systems are illustrated in U.S. Patent Specifications Nos. 2,836,993; 3,021,997; 3,493,118; 3,922,891 and 3,922,892.

Other washing machine tub suspension systems employed in the prior art include inverted, interfacing convex members for supporting the vertically mounted rotatable spin tub. Examples of such systems are shown in U.S. Patent Specifications Nos. 3,277,742; 3,285,419; 3,535,897 and 3,598,460.

While the above described suspension systems reduce to some extent the transfer of vibration from the spin tub to the washing machine housing and base, the systems provide damping of vibrations only for relatively small out-of-balance loads.

Other remedies for diminishing the vibrations produced in a spinning wash tub by an out-of-balance load have been devised. One such remedy includes the provision of a weighted ring, commonly referred to as a "balance ring", placed along or near the upper rim of the spin tub. The theory is based on the principle of a spinning toy top; i.e., that the weighted ring placed at or very near the head of the top tends to produce a balanced spinning thereof. While such rings do aid in stabilizing out-of-balance spinning wash tubs, they alone do not satisfactorily solve the out-of-balance problem.

Accordingly, it is an object of the present invention to provide an improved suspension system for counteracting and stabilizing an out-of-balance condition in the spin tub of a clothes washing machine, thereby minimizing vibrations, and which is relatively simple in design.

The invention is defined in claim 1 below.

Briefly, a preferred embodiment of the invention includes a base having a truncated, hemispherical cup formed therein. A complementarily shaped support cup is secured by rigid legs to an outer stationary tub of the washing machine. The support cup is seated in the base cup and is pivotal therein. In one embodiment, a felt pad impregnated is provided with lubricant between the cups. Alternatively, an intermediate cup shaped member of a plastics material having low friction qualities, can be positioned between the base and support cups.

Coiled retaining springs are tensioned between the bottom of the outer tub and the base. An inner rotatable spin tub is located within the outer tub and is mounted on a central shaft which extends downwardly through the outer tub in the direction of the support cups. A pulley is mounted on the lower end of the shaft, above the mated cups. A motor mounted on the base is coupled to the pulley by a belt. A transmission unit is also provided on the shaft above the pulley. The transmission unit functions to transfer rotation of the shaft in one direction only to an agitator for washing articles of clothing placed in the tub and to rotate the entire inner tub at relatively high speed in the opposite direction during the spin cycle. The pulley assembly, a brake assembly and transmission form a drive mechanism for the washing machine.

A balance ring is mounted on the transmission housing for rotation therewith, directly beneath the bottom wall of the outer tub. This location is as near to the true centre of mass of the spinning tub and rotating drive mechanism as is practical. The balance ring is preferably of a moulded plastics construction, forming a hollow trench which is filled with concrete, for example, to provide the proper weight. The location of the balance ring is of special importance. Placement of the ring as described ensures that the rotating spin tub remains in balance even under increased out-of-balance weight distribution of the clothes being spun therein.

The combination of the mating hemispherical cup support and the balance ring provides increased stability to the washer tub, especially during the spin cycle, thus minimizing vibration of the washing machine housing and base.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side sectional view of a clothes washing maching embodying the invention;

Figure 2 is a fragmentary perspective view of the base, outer stationary tub, motor and suspension system of the washing machine;

Figure 3 is an exploded, fragmentary, perspective view of the suspension system included in the washing machine;

Figure 4 is a perspective view of a truncated, hemispherical support cup employed in the suspension system; and

Figure 5 is a fragmentary perspective view of a balance ring.

In Figure 1 a clothes washing machine 10 includes an outer housing 12, having side walls 14, a top 16 and a base 18. Adjustable feet 20

are attached to the base 18 to support and level the machine.

Within the housing 12 is mounted a clothes receiving tub assembly 22, which includes an outer, cylindrical, stationary tub 24 having a bottom 26 and a side wall 28. At the top of the stationary tub is a raised lip forming an opening 32 in the top wall 34 of the tub to permit clothes to be introduced and removed. An aligned opening 36 in the cover 16 provides access to opening 32. A hinged lid 38 closes off the opening 32.

The tub assembly and drive mechanism, to be described hereinafter, are supported on a plurality of rigid, incurved legs 40 attached to the outer stationary tub 24. In the preferred embodiment, three legs, spaced 120° apart, are used. The tops 42 (Figure 3) of the legs are attached, e.g. by bolts, to the lower rim of the side wall 28 of the outer tub. The bottoms of the legs converge and are attached to a convex, truncated, hemispherically shaped support cup 44 (see Figure 4). Brackets, 46 also spaced 120° about the larger diameter end 48 of the support cup, are provided for fastening the bottoms 50 of the legs 40 thereto, as shown in Figure 3. The outer surface 52 of the support cup is reasonably smooth and is received in a complementarily shaped, hemispherical cup 54 provided on the base 18 of the washing machine housing. In the preferred embodiment, the cup 54 is formed directly as a pressing in the base 18. A felt or other absorbent pad 56, having perforations therein, is bonded on the mating surface 58 of cup 54 as a cushion layer between the support and base cups 44 and 54. The felt pad is impregnated with a lubricant such as grease, to promote a smooth pivotal movement between the cups. Alternatively, a preformed plastics cup having low friction surfaces can be introduced between the support and base cups to serve the same purpose as the lubricated felt pad.

A plurality of stabilizing coil springs 60 (Figure 1), are tensioned between the bottom of the stationary tub and the base 18. The ends of the springs are hooked into apertures 62, 64 in the tub wall and base, respectively. In the preferred embodiment, there are five springs equally spaced around the tub. Each spring is at about 20—25 pounds (89N to 111N) of tension.

The mating cups and stabilizing springs serve to maintain the tub assembly in an upright position as illustrated in the drawings, Figure 1 and 2.

Within the outer stationary tub is mounted, concentrically therewith, a slightly smaller diameter, cylindrical spin tub 66. The spin tub 66 is supported on a central shaft 68 which itself is supported in spaced bearing assemblies 70 and 72, see Figure 1. The bearing assembly 70 is mounted in a bearing block 74 which is welded or otherwise secured to the inner surface of the bottom 26 of the outer tub 24 and the bearing assembly 72 is secured to or is formed as a part of a support brace 76 extending between the legs 40.

The shaft 68 extends downwardly toward the centre of the hemispherical support cups 44, 54 and a pulley 78 is mounted on the shaft 68 at its lower end. The pulley is connected by a belt 80 to a pulley on the shaft 81 of an electric motor 82 mounted on the base 18 adjacent the support system. An idler wheel 84 is provided to ensure proper tensioning of the belt under various types of operation of the washing machine; i.e., agitation, spin, etc. The motor is used also to drive a water pump 86. The pump circulates and drains water via hoses such as 87, 89 to and from the wash tub assembly. A belt 88 extends between a smaller pulley 90 mounted on the shaft 81 of the motor and a pulley 92 of the pump.

Supported on a central shaft 68 of the washing machine is a transmission unit 94 of a conventional type employed in automatic washing machines. The transmission unit provides agitation movement of an inner shaft 98 of the central shaft 68 when the motor 82 is driven in a first direction. An agitator 96 removably mounted on the inner shaft 98 within the tub 66, is oscillated in a stepped rotation during the wash cycle, thereby to remove dirt from clothes placed in the tub. Reversal of the drive motor produces a spinning of the entire central shaft 68, transmission 90 and inner tub 66, at relatively high speeds in a direction opposite from that of the agitation cycle, for driving excess water from the clothes centrifugally after the rinse cycle. A brake assembly 100 included as a part of the washing machine drive mechanism, is located beneath the support brace 76. The brake assembly is employed to lock the central shaft 68 in a fixed position during the agitation cycle and to release the central shaft 68 for spinning during the spin cycle. The operation of the washing machine in the agitate and spin cycles as described, is conventional and forms no part of the present invention.

Mounted on the transmission housing by means of brackets 101 and fasteners, such as bolts 102 is a weighted "balance ring" 106. The preferred form of the balance ring 106 is shown in greater detail in Figure 5. The ring includes an outer moulded plastics shell 108 having a central hub portion 110 with a central aperture 112 extending therethrough and a circular trough 114 surrounding the central hub. Concrete 116 or other suitable material is introduced into the trough to give the balance ring a predetermined mass. Apertures 118 in the central hub portion surrounding the central aperture 112, are employed for mounting the balance ring on the transmission housing; see Figure 1.

The balance ring is located directly beneath the bottom wall of the outer tub 26. The ring spins with the transmission, the other drive mechanism components and the inner tub 66 during the spin cycle. The balance ring, in combination with the mating support cups 44, 54, provide great

stability to the inner tub 66 during the spin cycle, even when clothes pile up at one location in the tub and cause imbalance. The mating cups support the washing machine tubs in a fixed location, but permit the entire system to pivot thereat. Excessive sidewise movement is prevented by securing the outer tub to the base 18 by means of the coil springs 60, as described heretofore.

In a preferred embodiment of a washing machine including a suspension system according to the invention, the outer tub diameter is approximately 55 cm with the diameter of the inner tub being approximately 51 cm. In such case, a balance ring of approximately 40 cm diameter has been selected for mounting beneath the outer tub. This diameter was chosen to permit the mounted of the ring at this location without interfering with the legs 40 and other tub supporting structure of the washing machine. In such case, the weight of the balance ring is about 8 kg. If the ring were increased in diameter, a smaller weight could be employed. Conversely, a decrease in diameter requires a greater weight in the balance ring. Typical values are: 51 cm diameter balance ring—3.6 to 4.5 kg; 25 cm diameter balance ring—13.6 kg.

A typical speed during the spin cycle of preferred embodiment of the washing machine is approximately 600 rpm with a speed of 50—100 rpm being the most critical as the greatest oscillation has been found to occur at such speed. In the preferred embodiment, the diameter of the support cups is approximately 12—13 cm.

The system as shown permits up to a 3 kg out-of-balance load to be included in the inner wash tub before the tub will spin sufficiently out of its proper path to cause excessive vibration or engagement between the outer stationary tub and the enclosure. This is far superior to most prior art washing machine suspension systems.

The selection and placement of the balance ring as described; i.e., directly beneath the bottom of the outer tub, in combination with the support cup members, provides the great stability realized. The placement of the balance ring is as close to the true centre point of mass of the spinning tub and drive mechanism as is possible. In fact in the embodiment of the washing machine described, the true centre point is located at the bottom of the inner rototable tub 66, but mounting a balance ring at such location is impractical (and not advisable as it would interfere with the washing operation). The best practical location for mounting a balance ring is directly beneath the outer tub 24. The ring then does not interfere with the operation of the machine yet serves in conjunction with the support cup arrangement, to stabilize the washing machine tub assembly satisfactorily.

The advantages accrue from the provision of the mating support cup mounting which permits pivotal movement of the entire washing machine tub assembly and drive transmission, but without lateral movement, in combination with the balance ring of a predetermined weight and size, located as close as possible to the true centre of mass of the rotating spin tub and drive mechanism. The selection of the proper balance ring weight, diameter, diameter of the support cups, etc., will vary with the size, capacity and diameter of the washing machine tubs.

Claims

1. A washing machine comprising a base and a wash tub assembly including an outer stationary tub and an inner, clothes receiving tub mounted on a central, upright shaft for rotation at spin speeds within the outer tub, the shaft extending downwardly through the bottom of the outer tub and being coupled to a motor mounted on the base, a suspension system supporting the tub assembly resiliently but stable, the suspension system including a first support part having a predetermined shape on the washing machine base, a rigid support member coupled at one end to the outer tub, a second support part shaped complementarily to the first support part and joined to the support member at its other end, the second support part mating with the first support part and the predetermined shape permitting pivotal movement of the outer tub, corresponding to tilting of the shaft, resilient support means extending between the outer tub and the base and a balance weight mounted on the shaft as near as practical to the centre of mass of the spinning tub and shaft, the balance weight rotating with the shaft upon rotation of the latter in a first direction at spin speed, the balance weight and suspension system cooperating to stabilize the tub assembly when a clothes load in the rotatable tub is out of balance.

2. A washing machine according to claim 1, wherein the first and second support parts are cup-shaped and one nests within the other.

3. A washing machine according to claim 2, wherein each cup-shaped support part is a truncated hemisphere.

4. A washing machine according to claim 2 or 3, wherein each cup-shaped support part opens upwardly, the second part nesting in the first part.

5. A washing machine according to claim 2, 3 or 4, wherein the first cup-shaped support is formed integrally in the base.

6. A washing machine according to any of claims 1 to 5, comprising a transmission unit attached to the shaft for rotation therewith upon rotation of the shaft in the first direction.

7. A washing machine according to claim 6, wherein the balance weight is mounted on the transmission unit adjacent the bottom of the stationary tub.

8. A washing machine according to any of claims 1 to 7, wherein the balance weight means is a ring-like member having a predetermined diameter and weight, joined to the shaft at the centre of the member.

9. A washing machine according to claim 8, wherein the ring-like member comprises a moulded housing having a central hub portion and

a circular trough surrounding the hub portion, the trough holding establishing the weight of the balance ring member.

10. A washing machine according to any of claims 1 to 9, further including a lubrication pad between the mating surfaces of the first and second support parts.

11. A washing machine according to claim 10, wherein the lubrication pad is a soft pad impregnated with a lubricant.

12. A washing machine according to claim 10 wherein the lubrication pad is formed of low friction material and shaped to mate between the first and second support parts.

13. A washing machine according to any of claims 1 to 12 wherein the resilient support means comprises a plurality of springs tensioned between the outer tub and the base around the periphery of the outer tub.

14. A washing machine according to any of claims 1 to 13, wherein the rigid support member includes a plurality of legs spaced about the periphery of the outer tub and attached at the top to the outer tub and at the bottom to the second support part.

15. A washing machine substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.